# CHAPTER 1
# INTRODUCTION

## 1-1. Purpose and scope.

*a*. This technical manual provides basic information for facilities personnel regarding the operation and maintenance of small heating systems and related equipment. Generally, the manual covers low pressure steam boilers (less than 15 psig), low pressure hot water boilers (less than 30 psig), space heaters, unit heaters, and warm air furnaces. The term "small" is used in the context of this manual to differentiate from the high pressure systems and equipment that are covered in detail in TM 5-650, Central Boiler Plants.

*b*. This manual makes reference to specific types of equipment commonly in use at Army installations. System and equipment descriptions contained in the manual are general in nature. Equipment manufacturers' technical literature and manuals should also be used for reference, training, and troubleshooting specific equipment.

## 1-2. References.

Related publications are listed in Appendix A.

## 1-3. Abbreviations and terms.

Abbreviations and special terms used in this manual are explained in the Glossary.

## 1-4. Organization and responsibility.

The operating and maintenance personnel for heating systems are organized in accordance with the applicable Army regulations and staffing guides. Supply and administrative support are provided by other divisions, branches, and/or sections within the Directorate of Engineering and Housing. There are significant differences at the installations in the quantity, type, and use of equipment. Therefore, personnel responsibilities may vary locally to provide the necessary operating and maintenance functions. In some cases, an individual may well perform both operation and maintenance. In all instances, coordination is required with the work management functions (planning, estimating, scheduling, recording data, etc.).

*a*. *Operating personnel.* Operating personnel have the responsibility to fire the equipment in the most efficient and economical manner. This includes the performance of equipment adjustments and simple routine maintenance work consistent with good operating practice.

*b*. *Maintenance personnel.* Maintenance personnel have the responsibility to maintain heating systems in good operating condition. This includes keeping equipment information files and necessary records of the maintenance work performed.

## 1-5. Systems overview.

The main heat conveying media for space heating systems are steam, hot water, and warm air.

*a*. *Steam*. Water heated to the boiling point evaporates and produces steam as long as heat is added. If the heat is removed or reduced, evaporation will stop or decrease. The quantity of heat contained in each pound of steam depends on its pressure and temperature. Steam can be generated and used as either saturated or superheated steam. Chapter 4 gives detailed information on steam systems.

(1) *Saturated steam.* For each steam pressure, there is a specific temperature at which the steam will become saturated. When steam is saturated, a drop in temperature or an increase in pressure will cause part of the steam to revert to water. There are two types of saturated steam: dry, i.e., without moisture; and wet, which is intermingled with moisture, mist or spray. Saturated steam is commonly used for space heating and process heat.

(2) *Superheated steam.* When steam has a temperature higher than its corresponding saturation pressure, it is called superheated steam. The difference between the temperature of superheated steam and its saturation temperature is called the superheat. Usually, superheated steam is generated in central heating plants when necessary to avoid condensation in the steam lines of the plant and the distribution system, or to drive steam turbines. Normally in such instances, not more than 50F superheat is imparted to the steam.

(3) *Total heat content.* A certain amount of heat is needed to change water into steam. The specific amount depends on the initial condition of the water and the desired pressure and temperature of the steam. The amount of heat required to convert water at 32F into steam at a specific pressure and temperature is called the total heat content (or enthalpy) of the steam at that particular pressure and temperature. As pressure rises from atmospheric conditions up to about 450 psia, the total heat content of dry saturated steam increases. At higher pressures, the total heat decreases as pressure increases. However, superheating increases the total heat content of the steam at any

pressure. Any thermodynamic steam table will show the total heat content of steam at different pressures and temperatures.

*b. Hot water.* Hot water is a very useful carrier of heat. Circulating in a closed system, the water absorbs heat in a boiler or heat exchanger and releases it to the heat using equipment. Hot water systems can be classified as high temperature, medium temperature, and low temperature. Chapter 5 gives detailed information on hot water systems.

(1) *High temperature water.* High temperature water (HTW), above 350F is usually generated in central heating plants and then delivered to the consumers by a distribution system. A heat exchanger is normally used in each building to convert the HTW into low temperature water for use in space heating.

(2) *Medium temperature water.* Supply water temperature for this type system ranges from 250F to 350F and is used for distribution systems, large space heaters, absorption refrigeration, and industrial purposes.

(3) *Low temperature water.* Supply water temperature for this type system is below 250F and is used for space heating. Generally, this manual covers low temperature hot water systems and equipment.

*c. Warm air.* Unlike steam and hot water, which are fed through pipes to space heating equipment from which heat is dispensed by radiation and convection, warm air supplies direct heat. In warm air systems, the cold air is heated by blowing it through a furnace casing or heat exchanger. The warmed air is then distributed through air ducts to the areas where heating is required. Chapter 6 gives detailed information on warm air systems.

## 1-6. Energy conservation policy.

*a.* All Army installations should have a management improvement program that includes policies and guidelines relating to the efficient use and conservation of utilities. Conservation measures should be implemented by supervisory, operating and maintenance personnel and by the users. The importance of keeping equipment properly used, adjusted, and maintained cannot be overemphasized.

*b.* Periodic reviews should be made of all factors influencing fuel selection to determine whether the fuel used still remains the most cost efficient for a particular installation. Also, the feasibility of improving or modernizing firing methods for current fuels should be considered.

*c.* The greatest boiler operating efficiency is obtained when units are operated at or near their full load ratings. Therefore, two boilers should never be operated if one can carry the load without exceeding its rating. Supervisors should review daily operating logs to insure proper boiler operation. Give specific attention to the percentage of $CO_2$ in the flue gas and temperature of the gas. These are good indicators of operating efficiency and depend on the proper balance between the rate of fuel feed, combustion air supply, draft, and stack temperature.

*d.* Periodically inspect heated facilities. Observe thermostat settings and advise users when incorrect settings are found. Correct settings may be posted. Also, identify those facilities where excessive heat is lost due to improper insulation and open doors or windows and take corrective actions.